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ABSTRACT

This document outlines the content standards for mathematics in the state of Colorado. The document is organized into six standards, each of which is subdivided into a series of lists defining what is expected of students at each grade level within the standard. The standards relate to number, algebra, data, geometry, measurement, and the linking of concepts and skills. A list of references is also included. (MM)

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COLORADO MODEL CONTENT STANDARDS FOR MATHEMATICS

Suggested Grade Level Expectations*

(*Suggestions for improvement are always welcome)

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Standard 1:

Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.

GRADES K-4

In grades K-4, what students know and are able to do includes

1.1 Demonstrating meanings for whole numbers, commonly used fractions and decimals (for example, 1/3, 3/4, 0.5, 0.75), and representing equivalent forms of the same number through the use of physical models, drawings, calculators, and computers.

Kindergarten students will:

- using objects and pictures, represent whole numbers from 0 to 50 in a variety of ways
- using two or more sets of objects, demonstrate which set is equal to, less than, or greater than the other set
- using concrete materials, demonstrate the meaning of wholes and parts (*for example, halves*)
- name pennies, nickels, dimes, quarters, and dollars

First grade students will:

- using objects and pictures, represent whole numbers from 0 to 100 in a variety of ways
- using objects, demonstrate the meanings of equal, less than, and greater than with the whole numbers 0 to 100
- apply equalities using the '=' symbol
- using concrete materials, demonstrate the meanings of halves, thirds, and fourths of sets and wholes
- demonstrate the value of nickels, dimes, quarters, and dollars in terms of pennies (*for example, 25 pennies = 1 quarter*)

Second grade students will:

- using objects and pictures, represent whole numbers including odds and evens from 0 to 1,000
- apply equalities and inequalities with whole numbers from 0 to 1,000 using the symbols =, ≠, <, >
- using concrete materials, demonstrate the meanings of fractions, including halves, thirds, fourths, eighths, and tenths of sets and wholes
- demonstrate equivalencies of coins (*for example, 5 nickels = 1 quarter)*
- combine coins up to $1.00 (*for example, 20¢ = 2 dimes = 1 dime + 2 nickels = 4 nickels*)

Third grade students will:

- using objects and pictures, represent whole numbers including odds and evens from 0 to 10,000
- apply equalities and inequalities with whole numbers from 0 to 10,000 using the symbols =, ≠, <, >
- using concrete materials (*for example, fraction strips*), compare and order fractions with like denominators, such as halves, thirds, fourths, eighths, and tenths
- demonstrate different combinations of coins for change (*for example, 52¢ = 2 quarters and 2 pennies*)
- using concrete materials, make change up to $1.00

Fourth grade students will:

- using objects and pictures, represent whole numbers including odds and evens from 0 to 1,000,000
- apply equalities and inequalities with whole numbers from 0 to 1,000,000 using the symbols =, ≠, <, >
- using concrete materials (*for example, fraction strips*), compare and order fractions with like and unlike denominators, such as halves, thirds, fourths, eighths, and tenths

- using concrete materials (*for example, base ten blocks*), represent the decimal fractions of tenths and hundredths

- using concrete materials, equate terminating decimals to their common fraction equivalents (*for example, 0.25 = 1/4*)

- demonstrate different combinations of currency and coins for change (*for example, $2.39 = 2 dollar bills, 1 quarter, 1 dime, and 4 pennies*)

- using concrete materials, count change from the cost of the item, where the item costs no more than $10.00, up to the amount of money received

1.2 Reading and writing whole numbers and knowing place-value concepts and numeration through their relationships to counting, ordering, and grouping.

Kindergarten students will:

- read and write numerals from 0 to 10 in meaningful contexts

- group objects into sets of ten

First grade students will:

- read and write numerals from 0 to 100 in meaningful contexts

- read the number words for zero to ten

- group objects by ones and tens

- order according to place value (*for example, given 9 ones and 2 tens, the student can write the number 29; given the number 29 the student can show 2 tens and 9 ones*)

- write one- and two-digit whole numbers in expanded form (*for example, 29 = 20 + 9*)

Second grade students will:

- read and write numerals from 0 to 1,000 in meaningful contexts

- read and write the number words for zero to one hundred

- group objects by ones, tens, and hundreds

- order according to place value (*for example, given 9 ones, 5 tens, and 4 hundreds, the student can write the number 459; given the number 459, the student can show 4 hundreds, 5 tens, and 9 ones*)

- write three-digit numbers in expanded form (*for example, 459 = 400 + 50 + 9*)

Third grade students will:

- read and write numerals from 0 to 10,000 in meaningful contexts

- read and write the number words for selected numbers from zero to one thousand

- order according to place value (*for example, given 9 ones, 5 tens, 4 hundreds, and 7 thousands, the student can write the number 7,459; given the number 7,459, the student can show 7 thousands, 4 hundreds, 5 tens, and 9 ones*)

- identify place value through ten thousands (*for example, in 86,243, '6' is in the thousands place)*

- write four-digit numbers in expanded form (*for example, 7,459 = 7,000 + 400 + 50 + 9*)

Fourth grade students will:

- read and write numerals from 0 to 1,000,000 in meaningful contexts

- read the number words for selected numbers from zero to one million

- write the number words for selected numbers from zero to one hundred thousand

- order according to place value (*for example, given 9 ones, 5 tens, 4 hundreds, 7 thousands, and 8 hundred thousands, the student can write the number 807,459; given the number 807,459, the student can show 8 hundred thousands, 7 thousands, 4 hundreds, 5 tens, and 9 ones*)

- identify place value through hundred thousands (*for example, in 807,459, '8' is in the hundred thousands place*)

- write six-digit numbers in expanded form (*for example, 807,459 = 800,000 + 7,000 + 400 + 50 + 9*)

- relate decimals and fractions (that is, tenths and hundredths) to one another using objects and pictures

1.3 Using numbers to count, to measure, to label, and to indicate location.

Kindergarten students will:

- count from 1 to 50
- use one-to-one correspondence to count and compare sets of objects containing 0 to 10 members
- starting with any whole number less than 50, count forward to 50
- use ordinal positions for first through tenth
- sequence whole numbers from 0 to 10 (*for example, 5 is before 7; 5 is after 4*)

First grade students will:

- count from 1 to 20 by 2's
- count from 1 to 100 by 1's, 5's, and 10's
- starting with any whole number less than 100, count forward to 100
- use ordinal positions for first through twentieth
- sequence selected whole numbers from 0 to 100

Second grade students will:

- count by 1's, 2's, 5's, and 10's
- count from 1 to 1,000 by 100's
- starting with any whole number less than 1,000, count forward to 1,000
- use ordinal positions for first through thirty-first
- sequence selected whole numbers from 0 to 1,000
- locate and label the halfway point between whole numbers on the number line
- locate and label a point in the first quadrant of the coordinate plane (*for example, locates the point (4,1)*

Third grade students will:

- count forward from any even number by 2's; and from any number by 10's and 100's (*for example, 216, 316, 416, 516, ...)*
- use ordinal positions for selected whole numbers greater than thirty-first
- sequence selected whole numbers form 0 to 10,000
- locate and label 1/2's and multiples of 1/4's between whole numbers on the number line
- locate and label a point in the first quadrant of the coordinate plane (*for example, locates the point (11,15)*

Fourth grade students will:

- count forward from any number by 2's, 3's, 5's, 10's, and 100's
- sequence selected whole numbers from 0 to 100,000
- locate and label 1/2's and multiples of 1/4's and 1/3's between whole numbers on the number line
- locate and label a point in the first quadrant of the coordinate plane (*for example, locates the point (27,15)* and on a city map (*for example, (E23, 11)*

1.4 Developing, testing and explaining conjectures about properties of whole numbers, and commonly used fractions and decimals (for example, 1/3, 3/4, 0.5, 0.75).

Kindergarten students will:

- describe the concept of zero

First grade students will:

- know the commutative property of addition of whole numbers
- verify the addition and subtraction properties of zero with whole numbers

Second grade students will:

- verify the commutative and associative properties of addition of whole numbers

- verify that subtraction of whole numbers is not commutative

Third grade students will:

- verify the commutative and associative properties of addition and multiplication of whole numbers
- verify the multiplication properties of zero and one with whole numbers

Fourth grade students will:

- verify division of whole numbers is not commutative
- continue to verify number properties from previous grades

1.5 Using number sense to estimate and justify the reasonableness of solutions to problems involving whole numbers, and commonly used fractions and decimals (for example, 1/3, 3/4, 0.5, 0.75).

Kindergarten students will:

- estimate a reasonable quantity for a given number of objects less than 20
- describe a relationship between two sets of quantities with more, less, or equal numbers of objects

First grade students will:

- estimate a reasonable quantity for a given number of objects from 0 to 100

Second grade students will:

- estimate sums and differences first by rounding to the nearest ten prior to performing the operation, and, then, using the estimate to determine the reasonableness of the solution

Third grade students will:

- estimate sums and differences first by rounding to the nearest ten and hundred prior to performing the operation and, then, using the estimate to determine the reasonableness of the solution

- estimate products first by rounding to the nearest ten prior to performing the operation, and then using the estimate to determine the reasonableness of the solution

Fourth grade students will:

- estimate sums and differences first by rounding to the nearest ten, hundred, and thousand prior to performing the operation, and then using the estimate to determine the reasonableness of the solution

- estimate products first by rounding to the nearest ten and hundred prior to performing the operation and, then, using the estimate to determine the reasonableness of the solution

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

1.1 Demonstrating meanings for integers, rational numbers, percents, exponents, square roots, and pi (π) using physical materials and technology in problem-solving situations.

Fifth grade students will:

- locate commonly-used positive rational numbers, including fractions, mixed numbers, terminating decimals through thousandths, and percents, on the number line

- using concrete materials, demonstrate the meaning of integers

- using concrete materials, demonstrate the equivalence of commonly-used fractions, terminating decimals, and percents (*for example, 7/10 = 0.7 = 70%*)

- pictorially, demonstrate the meaning of square numbers

Sixth grade students will:

- continue to locate commonly-used positive rational numbers, including fractions, mixed numbers, terminating decimals through thousandths, and percents, on the number line

- locate integers on the number line

- identify subsets of integers, including counting and whole numbers
- demonstrate the equivalence of commonly-used fractions, decimals, and percents
- pictorially, demonstrate the meaning of square roots of perfect square numbers through 100

Seventh grade students will:

- locate integers and positive rational numbers on the number line (*for example, -6, 3/4, 1.81*)
- identify subsets of rational numbers, including counting and whole numbers and integers
- demonstrate the equivalence of positive fractions, decimals, and percents
- demonstrate the relationship of the circumference to the diameter of a circle as approximating
- demonstrate the meaning of square roots of perfect square numbers

Eighth grade students will:

- locate rational numbers and commonly-used irrational numbers on the number line (*for example, -7/2, -2.48, 0, 15/16, 2)*
- demonstrate the equivalence of fractions, terminating decimals, and percents of positive and negative rational numbers
- distinguish between the sets of rational and irrational numbers
- determine the two consecutive whole numbers between which the square root of a whole number lies (*for example, 72 lies between 8 and 9*)
- pictorially, demonstrate the meaning of commonly-used irrational numbers

1.2 Reading, writing, and ordering integers, rational numbers, and common irrational numbers such as √2 and √5 and π.

Fifth grade students will:

- read, write, and order positive rational numbers, including commonly-used fractions and terminating decimals through thousandths
- compare commonly-used proper fractions and terminating decimals using the symbols =, ≠, <, >

Sixth grade students will:

- read, write, and order positive rational numbers, including commonly-used fractions and terminating decimals through thousandths
- compare positive fractions and decimals using the symbols =, ≠, <, >

Seventh grade students will:

- read, write, and order integers and positive rational numbers
- compare integers and positive rational numbers using the symbols =, ≠, <, >

Eighth grade students will:

- read, write, and order rational numbers and commonly-used irrational numbers
- compare rational numbers and commonly-used irrational numbers using the symbols =, ≠, <, >

1.3 Applying number theory concepts (for example, primes, factors, multiples) to represent numbers in various ways.

Fifth grade students will:

- identify factors, multiples, and prime composite numbers
- write the prime factorization of whole numbers up to 50 (*for example, 36 = 2 • 2 • 3 • 3*)
- relate exponential notation to repeated multiplication (*for example, 81 = 3 • 3 • 3 • 3 = 81*)

- write whole numbers in expanded form without powers of ten (*for example, 579 = 500 + 70 + 9 = (5 x 100) + (7 x 10) + (9 x 1)*)

- demonstrate the divisibility rules for 2, 5, and 10

- demonstrate an = a • a • ... • a, where 'a' and 'n' are counting numbers

Sixth grade students will:

- write the prime factorization of whole numbers in exponential form (*for example, 36 = 2 2 • 3 2*)

- write whole numbers in expanded form with powers of ten (*for example, 579 = 500 + 70 + 9 = 5 x 100+ 7 x 10 + 9 x 1*)

- write large whole numbers using scientific notation (*for example, 246,000,000 = 2.46 x 10^8; 2.46 x 10^8 = 246,000,000*)

- demonstrate the divisibility rules for 2, 3, 5, 6, 9, and 10

- determine the greatest common factor and least common multiple of a pair of whole numbers

Seventh grade students will:

- express 100 as 1

- write rational numbers in expanded form without negative powers of ten (*for example, 579.42 = 5 x 100 + 7 x 10 + 9 x 1 + 4 x 1/10 + 2 x 1/100*)

- demonstrate the divisibility rules for 2, 3, 4, 5, 6, 9, and 10

- determine the greatest common factor and least common multiple of whole numbers using prime factorization

- demonstrate the meaning of an, where 'a' is a positive rational number and 'n' is a counting number

Eighth grade students will:

- write and use appropriately negative powers of ten (*for example, 1/102 = 10-2*)

- write rational numbers in expanded form with negative powers of ten (*for example, 579.42 = 5 x 100 + 7 x 10 + 9 x 1 + 4 x 10-1 + 2 x 10-2*)

- write very small rational numbers in scientific notation (*for example, .00036 = 3.6 x 10-4*)

- demonstrate the meaning of an, where 'a' is any rational number and 'n' is a counting number

1.4 Using the relationships among fractions, decimals, and percents, including the concepts of ratio and proportion, in problem-solving situations.

Fifth grade students will:

- demonstrate the meaning of ratio in different contexts

- use appropriate notation to express ratios, including a/b, a to b, and a: b

Sixth grade students will:

- represent fractions, decimals, and percents as ratios

- demonstrate the similarities and differences between ratios and fractions

- interpret and use ratios in different contexts (*e.g. batting averages, miles per hour*) to show the relative sizes of two quantities using appropriate notations, including a/b, a to b, a : b

Seventh grade students will:

- demonstrate the equivalent relationships among fractions, decimals, and percents

Eighth grade students will:

- apply proportional reasoning to solve problems

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

1.5 Developing, testing, and explaining conjectures about properties of integers and rational numbers.

Fifth grade students will:

- demonstrate the commutative, associative, and identity properties for addition and multiplication, and the multiplication property of zero for fractions

Sixth grade students will:

- demonstrate multiplication inverses of positive rational numbers (*for example, 1/9 • 9 = 1*)
- demonstrate that division by zero is undefined

Seventh grade students will:

- demonstrate properties for integers
- demonstrate the distributive property of multiplication over addition for whole numbers

Eighth grade students will:

- demonstrate properties for rational numbers, including closure

1.6 Using number sense to estimate and justify the reasonableness of solutions to problems involving integers, rational numbers, and common irrational numbers such as √2, √5, and π.

Fifth grade students will:

- estimate sums and differences of fractions and decimals using benchmarks (*for example, 5/6 + 7/8 must be equal to an amount less than 2, since each fraction is less than 1*)
- estimate, using appropriate techniques, determine, and, then, justify the reasonableness of solutions to problems involving whole numbers

Sixth grade students will:

- estimate, using appropriate techniques, determine, and, then, justify the reasonableness of solutions to problems involving whole numbers and sums and differences of commonly-used fractions and decimals

Seventh grade students will:

- estimate, using appropriate techniques, determine, and, then, justify the reasonableness of solutions to problems involving positive rational numbers

Eighth grade students will:

- estimate, using appropriate techniques, determine, and, then, justify the reasonableness of solutions to problems involving positive and negative rational numbers

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

1.1 Demonstrating meanings for real numbers, absolute value, and scientific notation using physical materials and technology in problem-solving situations.

High school students will:

- demonstrate the relationships among subsets of the real number system, including counting, whole, integer, rational, and irrational numbers, to one another
- compare and order sets of real numbers
- demonstrate the meaning of absolute value as distance on the number line
- convert repeating decimals to fractions, and vice versa
- use very large and very small numbers in real-life situations to solve problems (*for example, understanding the size of the national debt*)
- express numbers in scientific notation, and vice versa

1.2 Developing, testing, and explaining conjectures about properties of number systems and sets of numbers.

High school students will:

- demonstrate that the field properties, including closure, commutative, associative, distributive, identity, and inverse properties, apply to the real number system
- verify conjectures about number theory concepts applied to the real number system (*for example, the sum of two odd numbers is even*)
- verify and apply the laws of exponents

1.3 Using number sense to estimate and justify the reasonableness of solutions to problems involving real numbers.

High school students will:

- estimate, using appropriate techniques including rounding, solutions to problems involving real numbers
- determine and justify the reasonableness of solutions obtained using both estimation and exact computations
- appropriately apply strategies of estimation and/or exact computation in problem-solving situations

Standard 2:

Students use algebraic methods to explore, model and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

GRADES K-4

In grades K-4, what students know and are able to do includes

2.1 Reproducing, extending, creating, and describing patterns and sequences using a variety of materials (for example, beans, toothpicks, pattern blocks, calculators, unfix cubes, colored tiles).

Kindergarten students will:

- recognize, construct, and extend patterns in a variety of motions, colors, designs, sounds, rhythms, music, positions, sizes, or quantities

First grade students will:

- create and extend patterns using concrete materials (for example, uses pattern blocks to create a pattern and has another student extend the pattern)

Second grade students will:

- verbally describe patterns
- create and extend patterns using symbols, such as words and numbers
- find missing elements of a repeating pattern (for example, 1,3, __,7)

Third grade students will:

- reproduce, extend, create, and describe patterns, such as in common fractions, geometric shapes, money, measurement, addition, subtraction, and multiplication facts
- find missing elements of patterns of multiples

Fourth grade students will:

- reproduce, extend, create, and describe patterns, such as in common fractions, geometric shapes, measurement, addition, subtraction, multiplication, and division facts

- find missing elements of a complex repeating pattern (for example, 1,1,2,3,5,__,13,...)

2.2 Describing patterns and other relationships using tables, graphs, and open sentences.

Kindergarten students will:

- sort, classify, describe, and order collections of objects in a variety of ways (for example, sorts buttons into two groups and explains why he/she sorted them this way)

First grade students will:

- continue the pattern given in a table of data using numbers and/or concrete materials

Second grade students will:

- match tables and graphs of points on a coordinate plane

Third grade students will:

- given data, extend a table and plot points on a coordinate plane

Fourth grade students will:

- match tables, graphs, and open sentences that represent the same numerical pattern

***2.3** Recognizing when a pattern exists and using that information to solve a problem.*

Kindergarten students will:

- recognize when a pattern exists, describe the pattern verbally, reproduce that pattern, and create a new pattern (for example, describes red, blue, red, blue as an AB, AB pattern)

First grade students will:

- continue a pattern from a table and verbally describe the pattern

Second grade students will:

- verbally describe the relationship between a graph and a table

Third grade students will:

- identify a rule using addition or subtraction and solve a problem using the rule

Fourth grade students will:

- identify a rule using addition, subtraction, or multiplication, and solve a problem using the rule

***2.4** Observing and explaining how a change in one quantity can produce a change in another (for example, the relationship between the number of bicycles and the numbers of wheels).*

First grade students will:

- using concrete or pictorial patterns, determine how the change in one variable affects the change in another (for example, how changing the number of bicycles changes the number of wheels)

Second grade students will:

- using concrete or pictorial patterns, determine how the change in one variable affects the change in another (for example, how changing the number of hands changes the number of fingers)

Third grade students will:

- determine how the change in one variable affects the change in the other by addition or subtraction

Fourth grade students will:

- determine how the change in one variable affects the change in the other by addition, subtraction, or multiplication

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

***2.1** Representing, describing, and analyzing patterns and relationships using table's graphs, verbal rules, and standard algebraic notation.*

Fifth grade students will:

- represent, describe, and analyze patterns for relationships involving whole numbers and common proper fractions
- recognize that a variable is used to represent an unknown quantity

Sixth grade students will:

- represent, describe, and analyze patterns for relationships involving positive rational numbers
- use variables such as boxes, letters, or other symbols to describe a general rule and to solve problems

Seventh grade students will:

- represent, describe, and analyze patterns with positive rational numbers and integers
- identify the algebraic terms 'expression', 'equation', 'term', 'variable',' coefficient', and 'constant'

Eighth grade students will:

- represent, describe, and analyze patterns with rational numbers

2.2 Describing patterns using variables, expressions, equations, and inequalities in problem-solving situations.

Fifth grade students will:

- solve problems from patterns involving whole numbers and common proper fractions using tables, graphs, and rules

Sixth grade students will:

- solve problems from patterns involving positive rational numbers using tables, graphs, and rules

Seventh grade students will:

- solve problems from patterns involving positive rational numbers and integers using tables, graphs, and rules

Eighth grade students will:

- solve problems from patterns involving rational numbers using tables, graphs, and rules

2.3 Analyzing functional relationships to explain how a change in one quantity results in a change in another (for example, how the area of a circle changes as the radius increases, or how a person's height changes over time).
Fifth grade students will:

- in any functional relationship involving whole numbers and common proper fractions, describe how a change in one quantity affects the other

Sixth grade students will:

- in any functional relationship involving positive rational numbers, describe how a change in one quantity affects the other

Seventh grade students will:

- in any functional relationship involving positive rational numbers and integers, describe how a change in one quantity affects the other

Eighth grade students will:

- in any functional relationship involving rational numbers, describe how a change in one quantity affects the other
- in a linear function, explain the meaning of slope as a rate of change
- identify independent and dependent variables

2.4 Distinguishing between linear and nonlinear functions through informal investigations.

Fifth grade students will:

- graph discrete linear and nonlinear functions
- match a description of a situation with its continuous graph

Sixth grade students will:

- graph discrete linear and nonlinear functions
- graph a continuous linear function for a given situation

Seventh grade students will:

- graph discrete linear and nonlinear functions
- graph a continuous nonlinear function for a given situation

Eighth grade students will:

- graph discrete linear and nonlinear functions
- graph and distinguish between continuous linear and nonlinear functions, such as,
  $y = 3x + 2$, $y = x^2$, and $y = x^3$, either by creating a table or using technology

2.5 Solving simple linear equations in problem-solving situations using a variety of methods (informal, formal and graphical) and a variety of tools (physical materials, calculators and computers).

Fifth grade students will:

- solve problems involving linear relationships in whole numbers
- solve simple linear equations with coefficients of 1 by informal methods using manipulatives, tables, graphs, or technology

Sixth grade students will:

- solve problems involving linear relationships in positive rational numbers
- solve simple linear equations with whole number coefficients by informal methods using manipulatives, tables, graphs, or technology

Seventh grade students will:

- translate written expressions or equations to algebraic expressions or equations, and vice versa
- using formal methods, solve one-step linear equations involving integers
- solve linear equations with variables and constants on both sides of the equation by informal methods using manipulatives, tables, graphs, or technology

Eighth grade students will:

- translate written expressions or equations to algebraic expressions or equations, and vice versa
- using formal methods, solve one-step linear equations involving rational numbers
- solve linear equations involving integers with variables and constants on both sides of the equation

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

2.1 Modeling real-world phenomena (for example, distance-versus-time relationships, compound interest, amortization tables, mortality rates) using functions, equations, inequalities, and matrices.

High school students will:

- use matrices to model real-world problems
- use a variety of functions, linear and nonlinear, to represent real-world and mathematical relationships

- use a variety of equations and inequalities to represent real-world and mathematical relationships

- use sequences to represent real-world applications

2.2 Representing functional relationships using written explanations, tables, equations, and graphs, and describing the connections among these representations.

High school students will:

- express relations in a variety of forms (for example, numerical, graphic, verbal and symbolic

- convert from one form to another

- describe a real-world situation using expressions, equations, inequalities, or matrices

- interpret a graphical representation of a real-world situation

2.3 Solving problems involving functional relationships using graphing calculators and/or computers as well as appropriate paper-and-pencil techniques.

High school students will:

- solve problems involving functions and relations using calculators, graphs, tables, and algebraic methods

- solve simple systems of equations and inequalities using algebraic or graphical methods

- solve literal equations (for example, solve for p in the equation I = prt)

2.4 Analyzing and explaining the behaviors, transformations, and general properties of types of equations and functions (for example, linear, quadratic, exponential).

High school students will:

- identify and interpret x- and y-intercepts in the context of a problem

- recognize when a relation is a function and determine its domain and range
- demonstrate horizontal and vertical translations on graphs of functions and their meanings in the context of a problem

2.5 Interpreting algebraic equations and inequalities geometrically and describing geometric relationships algebraically.

High school students will:

- graph solutions to equalities or inequalities in one- and two-dimensions
- use the Pythagorean Theorem
- express perimeter, area, and volume relationships of geometric figures algebraically
- use algebraic equations to describe properties of geometric figures such as square, rhombus, triangle, and parallelogram
- describe properties of lines and segments (e.g., slope, length, midpoint) algebraically

Standard 3:

Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems.

GRADES K-4

In grades K-4, what students know and are able to do includes

3.1 Constructing, reading, and interpreting displays of data including tables, charts, pictographs, and bar graphs.

Kindergarten students will:

- read and display simple picture and real object graphs
- gather data relating to familiar experiences by counting and tallying

First grade students will:

- gather data about recurring and quantifiable events (for example, daily temperature or attendance)
- display and explain data from a bar graph or tallies

Second grade students will:

- design a survey and collect data
- display data using tallies, bar graphs, pictographs, or tables
- transfer the same set of data to different displays (for example, from a table to a bar graph)

Third grade students will:

- select the appropriate type of graph to use in various problem-solving situations
- collect and display data using surveys, tallies, bar graphs, dot plots, pictographs, or tables
- use a computer to create bar and circle graphs
- use a timeline to display a sequence of events

Fourth grade students will:

- select the appropriate type of graph to use in various problem-solving situations
- collect and display data using line, dot plots, circle, or bar graphs
- use graph paper using the horizontal and vertical axes appropriately
- explain the basic concepts of sample bias and sample size when designing a survey

3.2 Interpreting data using the concepts of largest, smallest, most often, and middle.

Kindergarten students will:

- use "more" and "fewer" or "most," "same," and "fewest" to describe sets of manipulatives, pictures, or object graphs

First grade students will:

- using a bar graph, interpret data for "more" and "fewer" or "most," "same," and "fewest"

Second grade students will:

- interpret and compare data from displays, using the terms "least often," "most often", and "how much more" or "how much less"

Third grade students will:

- determine the median and mode from a data set
- using various displays of data, interpret and draw conclusions

Fourth grade students will:

- choose between median and mode to best describe the "middle" of a data set
- transfer the use of median and mode to other curricular areas
- using various displays of data, formulate questions, interpret, and draws conclusions

3.3 Generating, analyzing, and making predictions based on data obtained from surveys and chance devices.

Kindergarten students will:

- flip a two-colored counter or coin to generate and tally results

First grade students will:

- use survey data to make a prediction displayed on a bar graph
- spin a spinner such as to generate and record results
- analyze the results from flipping a two-colored counter or coin

Second grade students will:

- use survey data to make predictions about a larger similar population (for example, from a class survey make a prediction about all second graders in the school)
- roll a number cube to generate and record results
- analyze the results (including likely, more likely, less likely, and unlikely outcomes) of spinning a spinner
- recognize if different spinners are fair or unfair

Third grade students will:

- use survey data to make a prediction from various displays of data
- analyze the results of rolling a number cube
- predict the most likely outcome from spinners
- analyze the fairness of different spinners

Fourth grade students will:

- uses survey data to make and justify a real-world decision
- compare the outcomes of flipping a coin, spinning a spinner with four congruent sectors, and rolling a number cube

- analyze and predict which outcome is more likely from several events such as obtaining "heads" when flipping a coin, the spinner landing in one of the sectors, or rolling a "1" on a number cube

- analyze the fairness of various chance devices

3.4 Solving problems using various strategies for making combinations (for example, determining the number of different outfits that can be made using two blouses and three skirts).

First grade students will:

- determine the number of outcomes when flipping a coin

- using manipulatives or pictures, determine the possible combinations of matching a set containing one element with a set containing two elements

Second grade students will:

- determine the number of outcomes when spinning a spinner

- using manipulatives or pictures, determine the possible combinations of matching a set containing two elements with a different set containing two elements

Third grade students will:

- determine the number of outcomes when rolling a number cube

- using manipulatives or pictures, determine the possible combinations of matching a set containing two elements with a set containing three elements

Fourth grade students will:

- determine the number of outcomes obtained from a variety of chance devices
- using paper-and-pencil techniques (for example, tree diagrams), display the possible combinations of matching two sets of elements

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

3.1 Reading and constructing displays of data using appropriate techniques (for example, line graphs, circle graphs, scatter plots, box plots, stem-and-leaf plots) and appropriate technology.
Fifth grade students will:

- differentiate between categorical and numerical data
- organize and display data using appropriate graphs, such as line, bar, circle, dot plots, frequency tables, and stem-and-leaf
- read, interpret, and draw conclusions from various displays of data

Sixth grade students will:

- organize and display data using appropriate graphs, such as line, bar, circle, dot plots, frequency tables, stem-and-leaf, and histograms
- read, interpret, and draw conclusions from various displays of data

Seventh grade students will:

- organize and display data using appropriate graphs, such as line, bar, circle, dot plots, frequency tables, stem-and-leaf, histograms, scatter plots, and box-and-whiskers
- read, interpret, and draw conclusions from various displays of data

Eighth grade students will:

- organize and display data using appropriate graphs, such as line, bar, circle (using ratios to determine degrees and draw with protractors), dot plots, frequency tables, stem-and-leaf, histograms, scatter plots, box-and-whiskers
- read, interpret, and draw conclusions from various displays of data

3.2 Displaying and using measures of central tendency, such as mean, median, and mode, and measures of variability, such as range and quartiles.

Fifth grade students will:

- determine the mean of a set of data using manipulatives
- informally distinguish between mean, median, and mode

- determine the range of a set of data

- given various displays of the same set of data (line, bar, circle, and stem-and-leaf), determine which measure of central tendency is most evident

Sixth grade students will:

- determine the mean of a set of data by using an algorithm

- formally distinguish between mean, median, and mode

- given various displays of the same set of data (line, bar, circle, stem-and-leaf, and histograms), determine which measure of central tendency is most evident

Seventh grade students will:

- determine the quartiles of a set of data

- demonstrate the basic concepts of frequency distribution, percentiles, and dispersion of data (for example, evenly distributed, one or more outliners)

- given various displays of the same set of data (line, bar, circle, stem-and-leaf, histograms, and box-and-whiskers), determine which measure of central tendency is most evident

- given sets of data, identify the most appropriate measure of central tendency which typifies each set

Eighth grade students will:

- state the purpose of using measures of central tendency and variability with data sets

- create sets of data with the same mean and different ranges and compare the variability

- in a problem-solving situation, select the most appropriate display and measure of central tendency to solve the problem

3.3 Evaluating arguments that are based on statistical claims.

Fifth grade students will:

- critically evaluate line graphs, bar graphs, pictographs, or dot plots which do not begin at zero

Sixth grade students will:

- recognize a misleading display of data due to scaling
- critically evaluate biased sampling of a survey

Seventh grade students will:

- determine the improper computation of percent in articles or advertising
- evaluate and correct an improperly selected measure of central tendency

Eighth grade students will:

- determine the improper computation of percent increase or decrease
- recognize a misleading display of data which arises from area and volume models

3.4 Formulating hypotheses, drawing conclusions, and making convincing arguments based on data analysis.

Fifth grade students will:

- distinguish between a census and a survey
- explain why there may be differences in the data of two or more samples

Sixth grade students will:

- demonstrate the meaning of random sampling and biased versus unbiased samples

Seventh grade students will:

- critically evaluate survey questions and possible errors in experimental designs

- use appropriate simulations to collect and analyze data

Eighth grade students will:

- display, analyze, and draw conclusions from a given set of data or student-generated set of data

3.5 Determining probabilities through experiments or simulations.

Fifth grade students will:

- apply probability terms such as event, outcome, trials, and sample space
- assign a number between 0 and 1, inclusive, to the probability of an event
- perform experiments of independent compound events to estimate probability

Sixth grade students will:

- pictorially demonstrate the equivalence of probabilities as either a common fraction, decimal, or percent
- assigns 0% to an impossible event and 100% to a certain event
- performs experiments of independent compound events to estimate probability

Seventh grade students will:

- demonstrate the equivalence of probabilities as either a common fraction, decimal, or percent
- perform experiments of independent compound events with two different chance devices to estimate probability
- perform experiments of sampling with replacement to estimate probability

Eighth grade students will:

- perform experiments of simple independent and dependent events to estimate probability
- perform experiments to estimate the probability of complementary events

3.6 Making predictions and comparing results using both experimental and theoretical probability drawn from real-world problems.

Fifth grade students will:

- predict the probability of independent compound events, such as tossing two coins or determining the gender of two children in a family, and conduct an experiment or simulation to determine the probability
- demonstrates that the sum of the probabilities equals one (as applied to the sample space)
- using one chance device, such as a number cube or a spinner, design a fair game and an unfair game, and write the directions for each game

Sixth grade students will:

- predict the probability of independent compound events, such as the sum of two number cubes, conduct an experiment or simulation to determine the probability, and assign the probability to all possible sums of two number cubes
- demonstrate that the sum of all probabilities of two number cubes equals one
- using two chance devices, such as two number cubes or two spinners, design a fair game, and an unfair game, and write the directions for each game

Seventh grade students will:

- predict the probability of independent compound events with two different chance devices and conduct an experiment or simulation to determine the probability
- demonstrate that the probability of independent compound events is the same as the product of the probabilities of the two simple events
- demonstrate that the sum of all the probabilities of the events in a sample space is equal to one
- analyze games of chance to determine whether they are fair or unfair; if unfair, decide which player has a greater probability of winning and find that probability

Eighth grade students will:

- determine the probability of independent, dependent, and complementary events with replacement and without replacement
- analyze games of chance to determine whether they are fair or unfair; if unfair, rewrite the rules of the game to make it fair

3.7 Using counting strategies to determine all the possible outcomes from an experiment (for example, the number of ways students can line up to have their picture taken).

Fifth grade students will:

- determine the number of outcomes of independent compound events, such as tossing two coins or determining the gender of two children in a family by making a list or tree diagram

Sixth grade students will:

- determine the number of outcomes of independent compound events, such as the sum of tossing two number cubes by making a list or tree diagram

Seventh grade students will:

- determine the number of outcomes of independent compound events involving two different chance devices by making a list or tree diagram

Eighth grade students will:

- determine the number of outcomes of independent compound events by using the fundamental counting principle (for example, if one choice occurs in "m" ways and the second choice occurs in "n" ways, then the number of ways for them to occur together is m x n)
- use Pascal's triangle to determine how many and which outcomes occur for independent compound events with exactly two outcomes

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

3.1 Designing and conducting a statistical experiment to study a problem, and interpreting and communicating the results using the appropriate technology (for example, graphing calculators, computer software)

High school students will:

- determine the type of data (that is, categorical or numerical) to be collected in the design of a statistical study
- determine the factors which may affect the outcome of the survey (for example, biased questions or collection methods)
- draw conclusions about a large population based upon a properly chosen random sample
- select and use an appropriate display to represent and describe a set of data (for example, scatter plot, line graph, histogram)

3.2 Analyzing statistical claims for erroneous conclusions or distortions.

High school students will:

- check a graph, table, or summary for misleading characteristics
- recognize the misuse of statistical data in written arguments
- describe how data can be interpreted in more than one way or be used to support more than one position in a debate
- describe how the responses to a survey can be affected by the way the questions are phrased and/or by the reader's bias

3.3 Fitting curves to scatter plots using informal methods or appropriate technology to determine the strength of the relationship between two data sets and to make predictions.

High school students will:

- graph data sets, create a scatter plot, and identify the control (independent) variable and the dependent variable
- determine a line of best fit from a scatter plot using visual techniques

- identify the relationship (correlation) between variables as to direction and strength of the correlation

- predict values using the line of best fit

- show how extrapolation may lead to faulty conclusions

- use appropriate technology (for example, graphing calculator) as it relates to scatter plots, regression lines, and correlation

- recognize which model, linear or nonlinear, fits the data most appropriately

3.4 Drawing conclusions about distributions of data based on analysis of statistical summaries (for example, the combination of mean and standard deviation, and differences between the mean and median).

High school students will:

- differentiate between mean, median, and mode and demonstrate the appropriate use of each

- use technology to find the standard deviation

- recognize and classify various types of distributions (for example, bimodal, skewed, uniform, binomial, and normal)

- demonstrate how the mean and standard deviation affect the location and shape of the normal curve

- demonstrate how outliners might affect various representations of data, measures of central tendency, and standard deviation

3.5 Using experimental and theoretical probability to represent and solve problems involving uncertainty (for example, the chance of playing professional sports if a student is a successful high school athlete).

High school students will:

- determine the probability of an identified event using the sample space

- distinguish between experimental and theoretical probability and use each appropriately

- differentiate between independent and dependent events to calculate the probability in real-world situations

- use a complementary event to solve a problem
- apply the addition rule or multiplication rule appropriately in probability problem-solving situations
- use a geometric model to represent probabilities (for example, the probability of hitting the bull's eye region in a target)

3.6 Solving real-world problems with informal use of combinations and permutations (for example, determining the number of possible meals at a restaurant featuring a given number of side dishes).

High school students will:

- differentiate between and calculate permutations and combinations
- apply the fundamental counting rule, a permutation, or a combination appropriately
- determine probabilities of real-world problems using appropriate counting techniques
- use tree diagrams, lists, and/or other methods to show outcomes

Standard 4:

Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

GRADES K-4

In grades K-4, what students know and are able to do includes

4.1 Recognizing shapes and their relationships (for example, symmetry and congruence) using a variety of materials (for example, pasta, boxes, pattern blocks).

Kindergarten students will:

- place manipulatives on pictures of shapes congruent to the manipulatives

First grade students will:

- recognize two-dimensional congruent figures in different positions
- create simple designs using concrete materials such as tangrams and pattern blocks

Second grade students will:

- identify congruent figures from a selection of similar figures
- slide, flip, and turn concrete materials such as tangrams and pattern blocks to create and reproduce simple designs
- describe symmetry
- identify lines of symmetry of squares and rectangles

Third grade students will:

- compare similarities and differences between the concepts of similarity and congruence
- make a pattern by rotating, flipping, and sliding a two-dimensional figure
- identify lines of symmetry of regular hexagons, pentagons, and octagons

Fourth grade students will:

- define similarity and congruence
- identify the transformation that occurs when a figure is translated, reflected, or rotated
- identify the lines of symmetry of an equilateral triangle, parallelogram, and rhombus

4.2 Identifying, describing, drawing, comparing, classifying, and building physical models of geometric figures.

Kindergarten students will:

- recognize and identify circles, triangles, squares, rectangles, ovals (ellipses), and diamonds (rhombuses)
- using manipulatives (for example, straws or string loops), build circles, triangles, squares, rectangles, ovals (ellipses), and diamonds (rhombuses)

First grade students will:

- describe the number of sides in triangles and in quadrilaterals such as squares and rectangles
- draw triangles, squares, rectangles, and circles

Second grade students will:

- describe the attributes of circles, triangles, and quadrilaterals such as squares and rectangles
- identifies right angles and not-right angles
- recognize the three-dimensional figures: cubes, spheres, cylinders, cones, and pyramids
- draw right angles and not-right angles

Third grade students will:

- identify points, lines, line segments, and rays

- recognize and identify hexagons, pentagons, and octagons
- classify angles as obtuse, acute, or right
- draw obtuse, acute, and right angles
- compare what is the same and what is different between two-dimensional figures and three-dimensional figures
- draw rectangles and squares on a coordinate plane and identify the vertices with coordinates
- identify cubes, spheres, cylinders, cones, and pyramids
- build cubes (for example, with marshmallows and toothpicks) and spheres (for example, soap bubbles)

Fourth grade students will:

- identify parallel, perpendicular, and intersecting lines
- identify attributes of closed curves
- recognize and identify polygons including quadrilaterals such as trapezoids, parallelograms, and rhombuses
- draw geometric polygons including quadrilaterals such as trapezoids, parallelograms, and rhombuses
- describe squares as rectangles
- describe a right angle as having a measure of 90°
- classify triangles by their angles (obtuse, acute, right)
- draw obtuse, acute, and right triangles on a coordinate plane and identify the vertices with coordinates
- compare what is the same and what is different between two-dimensional figures and three-dimensional figures
- identify rectangular prisms

- recognize and identify in three-dimensional figures the vertices, edges, and faces

- build cubes, prisms, and pyramids (for example, using straws and string)

4.3 Relating geometric ideas to measurement and number sense.

Kindergarten students will:

- measure the lengths of the sides of triangles, squares, and rectangles using non-standard units (for example, cubes or paper clips)

First grade students will:

- measure the lengths of the sides of triangles, squares, rectangles to the nearest inch and centimeter

Second grade students will:

- measure the lengths of the sides of triangles, squares, and rectangles to the nearest half inch and centimeter

- measures the perimeter of triangles, squares, and rectangles using non-standard and standard units

Third grade students will:

- measure the sides and perimeters of geometric shapes to the nearest half inch and centimeter

- measure the area of geometric figures using nonstandard units

Fourth grade students will:

- measure the sides and perimeters of geometric shapes to the nearest fourth inch and centimeter

- measure the area of geometric figures using standard units

4.4 Solving problems using geometric relationships and spatial reasoning (for example, using rectangular coordinates to locate objects, constructing models of three-dimensional objects).

Kindergarten students will:

- use geometric shapes to solve a problem (for example, use geometric shapes to create a house)
- indicate positions of three or more objects or pictures (for example, left to right, top to bottom, next, last)
- combine triangular manipulatives to make a square, and square manipulatives to make a rectangle

First grade students will:

- draw a picture or diagram to solve a problem (for example, use a circle to create a clock face; fold a rectangle to show one half)
- manipulate pattern blocks to form a variety of geometric shapes

Second grade students will:

- draw a picture or diagram to solve a problem (for example, draw a map of the room to show how to get from a desk to the reading area; draw a map of the neighborhood)
- investigate and predict which pattern block shapes can be formed from the pattern block triangles
- investigate and predict the geometric shapes that result from cutting along a line of symmetry

Third grade students will:

- draw a picture or diagram to solve a problem (for example, use a number line to locate one half)
- investigate and predict geometric shapes by combining and subdividing groups of pattern blocks
- investigate and predict the result of changing the lengths of sides of polygons
- investigate and predict the geometric figures that result from cutting along a line of symmetry

Fourth grade students will:

- draw a picture or diagram to solve a problem (for example, uses triangular pattern blocks to create a star; uses pattern blocks to tile a plane)
- investigate and predict the changing of angles (for example, those made from the hands of a clock over time)
- investigate and predict what must occur for similar figures to become congruent figures
- investigate and predict the geometric figures that result from cutting along a line of symmetry

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

4.1 Constructing two- and three-dimensional models using a variety of materials and tools.

Fifth grade students will:

- using a straight edge and a compass, paper folding, or computer software application, demonstrate the geometric constructions of copying a segment and copying an angle
- build models of rectangular prisms including their nets
- given a three-dimensional model built with cubes, draw the two-dimensional orthogonal drawings (that is, the front view, right side view, and top view) and, conversely, given orthogonal drawings, build the model

Sixth grade students will:

- using a straight edge and a compass, paper folding, or computer software application, demonstrate the geometric construction of an angle bisector
- build models of triangular prisms including their nets
- given a three-dimensional model built with cubes, draw the orthogonal drawings (that is, the front view, right side view, and top view) and the foundation drawing (that is, the shape of the foundation, placement and the number of cubes that

are built on this foundation) and, conversely, given the orthogonal and foundation drawing, build the model

Seventh grade students will:

- using a straight edge and a compass, paper folding, or computer software application, demonstrate the geometric construction of a perpendicular bisector of a segment
- build models of cones, cylinders, pyramids and their nets
- given a three-dimensional model built with cubes, use isometric dot paper to draw the isometric drawing (that is, a drawing that shows the corner view and the top or bottom view) and, conversely, given the isometric drawing, build the model
- given nets, determine which would form a cube

Eighth grade students will:

- using a straight edge and a compass, paper folding, or computer software application, demonstrate the geometric constructions of a perpendicular to a point on a line segment, a perpendicular to a line from a point not on the line segment, and triangle congruence of Side-Side-Side, Side-Angle-Side, and Angle-Side-Angle
- build models of three-dimensional oblique solids
- given a three-dimensional model built with cubes, use isometric paper to draw the isometric drawing (that is, a drawing that shows the corner view and the top or bottom view), the orthogonal drawings (that is, the front view, right side view, and top view) and the foundation view (that is, the shape of the foundation, placement and the number of cubes that are built on this foundation) and, conversely, given the drawings, build the models

4.2 Describing, analyzing, and reasoning informally about the properties (for example, parallelism, perpendicularity, congruence) of two- and three-dimensional figures; and
4.3 Applying the concepts of ratio, proportion, and similarity in problem-solving situations.

Fifth grade students will:

- know that the measurement of an acute angle is less than 90°, a right angle is 90°, and an obtuse angle is greater than 90°
- uses correct geometric symbols for lines, segments, rays, and angles
- reason informally about properties of parallel lines, perpendicular lines, intersecting lines, line segments, and rays
- reason informally about properties (including lines of symmetry) of rectangles, squares, triangles (named by both lengths of sides and angles), and rectangular prisms
- reason informally about congruence involving rectangles, squares, triangles, and rectangular prisms

Sixth grade students will:

- describe complementary and supplementary angles
- use correct geometric symbols for parallelism, perpendicularity, and triangles
- reason informally about the properties (including lines of symmetry) of parallelograms, rhombuses, and triangular prisms
- reason informally about congruence involving parallelograms, rhombuses, and triangular prisms

Seventh grade students will:

- describe the properties of circles (including radius and diameter)
- recognize properties and use correct geometric symbols of overlapping geometric figures
- identify and reason informally about angle relationships formed by intersecting lines (for example, adjacent and vertical angles)
- reason informally about the properties (including lines of symmetry) of isosceles trapezoids and pyramids
- reason informally about the sides and angles of congruent and similar polygons

Eighth grade students will:

- identify and use correct notation for triangle congruence of Side-Side-Side, Side-Angle-Side, and Angle-Side-Angle
- reason informally about the relationships among angles formed by two lines cut by a transversal and two parallel lines cut by a transversal
- reason informally about the sum of the measures of the angles of a triangle equaling 180°
- reason informally about the properties of the special right triangles, 30°-60°-90° and 45°-45°-90°
- continue to reason informally about the sides and angles of congruent and similar polygons
- demonstrate proportional reasoning to indirectly determine lengths of segments of similar polygons

4.4 Solving problems using coordinate geometry.

Fifth grade students will:

- set up a coordinate graph (include axes, origin, and scale) and use it to mark and read coordinate pairs in the first quadrant
- from a scenario, choose the correct graph from given possible graph representations
- given a distance, find pairs of points on the coordinate plane in the first quadrant separated by that horizontal or vertical distance

Sixth grade students will:

- identify the four quadrants of the coordinate plane
- set up a coordinate graph (include axes, origin, and scale) and use it to mark and read coordinate pairs in all four quadrants
- draw a graph from a given scenario
- given a distance, find pairs of points on the coordinate plane separated by that horizontal or vertical distance

Seventh grade students will:

- set up a coordinate graph (include axes, origin, and scale) and use it to mark and read coordinate pairs in all four quadrants
- write a scenario from a given graph
- enlarge figures on a coordinate plane by positive integral scale factors
- reduce figures on a coordinate plane by the scale factor one-half
- describe the relationship between two different points on the coordinate plane
- given a distance, find pairs of points on the coordinate plane separated by that distance

Eighth grade students will:

- enlarge figures on a coordinate plane by rational scale factors
- reduce figures on a coordinate plane by rational scale factors
- determine the percent increase or decrease of perimeter and area of the enlargement or reduction of squares, rectangles and triangles
- describe the relationship of more than two points on the coordinate plane
- given a distance, find pairs of points on the coordinate plane separated by that distance
- determine the distance between a pair of points in the coordinate plane

4.5 Solving problems involving perimeter and area in two dimensions, and involving surface area and volume in three dimensions.

Fifth grade students will:

- solve problems involving perimeter and area of rectangles, squares, and triangles
- solve problems involving volume of rectangular prisms

Sixth grade students will:

- solve problems involving perimeter and area of parallelograms and rhombuses
- solve problems involving volume of triangular prisms
- solve problems involving surface area of rectangular prisms

Seventh grade students will:

- solve problems involving circumference and area of circles
- solve problems involving volume of cylinders
- solve problems involving surface area of triangular prisms

Eighth grade students will:

- solve problems involving perimeter and area of trapezoids
- solve problems involving volume of square pyramids and cones
- solve problems involving surface area of cylinders

4.6 Transforming geometric figures using reflections, translations, and rotations to explore congruence.

Fifth grade students will:

- use pattern blocks to tile a plane
- show lines of symmetry of geometric shapes

Sixth grade students will:

- tile a plane with polygons
- demonstrate clockwise and counterclockwise rotation with 90°, 180°, and 270° turns
- using models, demonstrate the multiple transformations which occur to get from one congruent figure to the other, and give a written explanation of the transformations

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Seventh grade students will:

- state and justify the types of polygons which will tile a plane
- state the coordinates to describe the translation of a figure on a coordinate plane

Eighth grade students will:

- determine the scale factor for dilations to illustrate similarity
- create Escher-type tessellations to illustrate congruence
- state the coordinates to describe the reflection of a figure across the x- and y-axes

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

4.1 Finding and analyzing relationships among geometric figures using transformations (for example, reflections, translations, rotations, dilations) in coordinate systems.

High school students will:

- describe and apply the properties of similar and congruent figures
- solve problems involving symmetry and transformations
- use coordinate geometry and/or tessellations to solve problems using geometric transformations
- describe cylinders, cones, and spheres that result from the rotation of rectangles, triangles, and semicircles about a line

4.2 Deriving and using methods to measure perimeter, area, and volume of regular and irregular geometric figures.

High school students will:

- use the Pythagorean Theorem and its converse to solve real-world problems

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- use known properties and formulas of polygons to find areas of regular and irregular figures

- use known properties and formulas of geometric solids to find volumes and surface areas of regular and irregular geometric solids

- use known properties of geometric figures in real-world applications

4.3 Making and testing conjectures about geometric shapes and their properties, incorporating technology where appropriate.

High school students will:

- make conjectures for properties of geometric figures and uses inductive and/or deductive reasoning to verify those conjectures

- use a formal process to prove geometric concepts (for example, direct, indirect, paragraph, or verbal proofs, flow charts, or constructions)

4.4 Using trigonometric ratios in problem-solving situations (for example, finding the height of a building from a given point, if the distance to the building and the angle of elevation are known).

High school students will:

- use right triangle trigonometry to solve real-world problems

- use properties of special right triangles to solve real-world problems

- recognize the relationship between slope and the tangent ratio

Standard 5:

Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

GRADES K-4

In grades K-4, what students know and are able to do includes

5.1 Knowing, using, describing, and estimating measures of length, perimeter, capacity, weight, time, and temperature; and
5.3 Demonstrating the process of measuring and explaining the concepts related to units of measurement.

Kindergarten students will:

- tell time to the nearest hour, using an analog and digital clock
- describe the units for measuring time
- estimate and measure length in non-standard units (for example, use cubes to measure the length of a hand)
- estimate the measurement of weight by "heavier" and "lighter"

First grade students will:

- tell time to the nearest hour and half-hour, using an analog and digital clock
- name the days of the week in order
- estimate and measures the length of objects to the nearest inch, foot and centimeter
- estimate and measure the capacity of a container in cups
- estimate and weigh an object on a balance with a non-standard unit
- measure temperature to the nearest 10°F
- describe the units for measuring time, length, capacity, and temperature

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- tell the number of minutes in an hour, days in a week, pennies in a nickel, dime, quarter, and dollar

Second grade students will:

- tell time to the nearest fifteen minutes, using an analog and digital clock
- use AM and PM
- estimate and measure the length of objects to the nearest half inch, foot, yard, centimeter, and meter
- estimate and measure the perimeter of a figure using non-standard and standard units
- estimate and measure the capacity of a container in cups, pints, quarts and gallons
- estimate and weigh an object on a balance with a non-standard unit and use a scale to measure an object to the nearest pound
- measures temperature to the nearest 2° and $10^{\circ}F$
- describe the units for measuring time, length, capacity, weight, and temperature
- know the number of hours in a day, months in a year, inches in a foot, feet in a yard, and cups in a pint

Third grade students will:

- tell time to the nearest five minutes, using an analog and digital clock
- estimate how long a minute is
- estimate and measure the length of objects
- estimate and measure the perimeter of an object with a string measured in U.S. customary and metric units
- estimate and measure areas using non-standard units
- estimate and measure the capacity of a container in cups, pints, quarts, gallons, and liters

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- estimate and weigh an object on a balance or scale to the nearest ounce
- measure temperatures in both Fahrenheit and Celsius
- describe the units for measuring time, length, area, capacity, and temperature
- know the number of seconds in a minute, hours in a day, days in a month, days in a year, pints in a quart, quarts in a gallon, and centimeters in a meter

Fourth grade students will:

- tell time to the nearest minute, using an analog and digital clock
- tell the number of minutes in a day, days in a year and when a leap year occurs
- describes the units for measuring time
- estimate the perimeters of similarly-sized figures (for example, trapezoids, parallelograms and rectangles), measure the sides, and determine the perimeters
- measure the lengths of the sides of squares and rectangles and determine the areas
- measure the lengths of the sides of cubes and determine the volumes
- estimate and measure the capacity of containers
- estimate and weigh objects on a balance to the nearest ounce and gram
- compare the relationship between the temperature in Fahrenheit and Celsius
- determine the distance between points on vertical and horizontal line segments on a coordinate plane
- given a distance, find pairs of points on the coordinate plane separated by that distance
- describe the units for measuring length, area, volume, capacity, and temperature in U.S. customary and metric units
- know the number of years in a decade and a century, feet in a mile, millimeters and centimeters in a meter, ounces in a pound, and pounds in a ton

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5.2 Comparing and ordering objects according to measurable attributes (for example, longest to shortest, lightest to heaviest).

Kindergarten students will:

- compare objects according to the measurable attributes of length and weight
- order objects according to the measurable attributes of length and weight
- compares and order various times (for example, morning comes before lunch)

First grade students will:

- compare objects according to the measurable attributes of length, capacity, weight, and temperature
- order objects according to the measurable attributes of length, capacity, weight, and temperature
- compare and order various times

Second grade students will:

- compare objects according to the measurable attributes of length, capacity, weight, and temperature
- order objects according to the measurable attributes of length, capacity, weight and temperature
- compare and order various times

Third grade students will:

- compare objects according to the measurable attributes of length, area, capacity, weight, and temperature
- order objects according to the measurable attributes of length, area, capacity, weight and temperature
- compare and order various times

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Fourth grade students will:

- compare objects according to the measurable attributes of length, area, volume, capacity, weight, and temperature in U.S. customary and metric units
- order objects according to the measurable attributes of length, area, volume, capacity, weight and temperature in U.S. customary and metric units
- compare and order various times

5.4 Using the approximate measures of familiar objects (for example, the width of your finger, the temperature of a room, the weight of a gallon of milk) to develop a sense of measurement.

First grade students will:

- use familiar objects as referents for measurement (for example, the length of the student's index finger is about two paper clips)

Second grade students will:

- use familiar objects as referents for measurement (for example, a second grader is a little taller than a meter)

Third grade students will:

- use familiar objects as referents for measurement (for example, the width of the index fingernail equals approximately one centimeter; ten pennies weigh approximately an ounce)

Fourth grade students will:

- use familiar objects as referents for measurement (for example, one paper clip equals one gram; the length of the arm span equals approximately one meter)

5.5 Selecting and using appropriate standard and non-standard units of measurement in problem-solving situations.

Kindergarten students will:

- select the appropriate units of measurement of time and length

First grade students will:

- select the appropriate units of measurement of time, length, capacity, and temperature

Second grade students will:

- select the appropriate units of measurement of time, length, capacity, weight, and temperature

Third grade students will:

- select the appropriate units of measurement of time, length, area, capacity, weight, and temperature

Fourth grade students will:

- select the appropriate units of measurement of time
- select the appropriate units of measurement of length, area, volume, capacity, weight, and temperature in U.S. customary and metric units

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

5.1 Estimating, using, and describing measures of distance, perimeter, area, volume, capacity, weight, mass, and angle comparison.

Fifth grade students will:

- estimate the length of the sides and height of rectangles, squares, triangles, and rectangular prisms
- estimate the perimeter and area of rectangles, squares, and triangles
- estimate the volume of rectangular prisms
- continue to estimate and use the capacity, weight, and mass measurements from previous grades
- estimate measures of angles (for example, 30°, 45°, 60°, 90°, 120°, 150°, 180°)

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Sixth grade students will:

- estimate the length of the sides and height of parallelograms and rhombuses
- estimate the perimeter and area of parallelograms and rhombuses
- estimate the volume of triangular prisms
- estimate the surface area of rectangular prisms
- continue to estimate and use the capacity, weight, and mass measurements from previous grades
- estimate measures of angles

Seventh grade students will:

- estimate the radius and diameter of circles
- estimate the circumference and area of circles
- compare the perimeter and area of transformed geometric figures
- estimate the volume of cylinders
- estimate the surface area of triangular prisms
- continue to estimate and use the capacity, weight, and mass measurements from previous grades
- estimate measures of angles

Eighth grade students will:

- estimate the length of the sides and height of trapezoids
- estimate the perimeter and area of trapezoids
- continue to compare the perimeter and area of transformed geometric figures
- estimate the volume of square pyramids and cones
- estimate the surface area of cylinders

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- continue to estimate and use the capacity, weight, and mass measurements from previous grades

- estimate measures of angles

5.2 Estimating, making, and using direct and indirect measurements to describe and make comparisons.

Fifth grade students will:

- compares the estimates and direct measurements obtained in benchmarks 5.1, 5.4, and 5.6

Sixth grade students will:

- compare the estimates and direct measurements obtained in benchmarks 5.1, 5.4, and 5.6

Seventh grade students will:

- compare the estimates and direct measurements obtained in benchmarks 5.1, 5.4, and 5.6

Eighth grade students will:

- compare the estimates and direct measurements obtained in benchmarks 5.1, 5.4, and 5.6

- demonstrate proportional reasoning to indirectly determine lengths of segments of similar polygons

5.3 Reading and interpreting various scales including those based on number lines, graphs, and maps.

Fifth grade students will:

- read and interpret scales on number lines, graphs, and maps

- select the appropriate scale for a given problem

Sixth grade students will:

- read and interpret scales on number lines, graphs, and maps

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- selects the appropriate scale for a given problem

Seventh grade students will:

- read and interpret scales on number lines, graphs, and maps
- select the appropriate scale for a given problem
- construct scale drawings

Eighth grade students will:

- read and interpret scales on number lines, graphs, and maps
- select the appropriate scale for a given problem
- construct scale drawings

5.4 Developing and using formulas and procedures to solve problems involving measurement.

Fifth grade students will:

- develop and use formulas for perimeter and area of rectangles, squares, and triangles using appropriate units
- develop and use the formula for volume of rectangular prisms using appropriate units

Sixth grade students will:

- develop and use formulas for perimeter and area of parallelograms and rhombuses using appropriate unit
- develop and use the formula for volume of triangular prisms using appropriate units

Seventh grade students will:

- demonstrate the relationship of circumference to diameter of a circle to approximate units

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- develop and use the formula for circumference and area of circles using appropriate units
- develop a procedure to find the area and perimeter of irregularly-shaped polygons
- develop and use the formula for volume of cylinders using appropriate units

Eighth grade students will:

- develop and use formulas for the perimeter and area of trapezoids using appropriate units
- develop and use the formula for volume of square pyramids and cones using appropriate units
- develop and use the Pythagorean Theorem
- use the relationships in 30-60-90 and 45-45-90 triangles to solve problems

5.5 Describing how a change in an object's linear dimensions affects its perimeter, area, and volume.

Fifth grade students will:

- describe how changes in one of the dimensions of a rectangle affects its perimeter and area
- using graph paper, demonstrate the changes in area of a rectangle having a constant perimeter and variable side lengths

Sixth grade students will:

- describe how changes in the base of a triangle affect its area when its height is constant
- describe how changes in one of the dimensions of a rectangular prism affects its volume

Seventh grade students will:

- describe how changes in the base of a parallelogram and rhombus affect its area when its height is constant

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- describe how scale factor changes in the dimensions of a rectangular prism affect its volume

- describe how changes in the distance between the bases of a triangular prism affect its volume

Eighth grade students will:

- describe how changing the radius of a circle affects the circumference and area

- describe how changing the height or radius of the base of a cylinder affects the volume

5.6 Selecting and using appropriate units and tools to measure to the degree of accuracy required in a particular problem-solving situation.

Fifth grade students will:

- select and use the appropriate units and tools to measure to the degree of accuracy required in a particular problem

- measure the length of the sides and heights of rectangles, squares, triangles, and rectangular prisms to the nearest inch and nearest centimeter

- measure and draw angles using a protractor (for example, 30°, 45°, 60°, 90°, 120°, 150°, 180°)

Sixth grade students will:

- select and use the appropriate units and tools to measure to the degree of accuracy required in a particular problem

- measure the length of the sides and heights of parallelograms and rhombuses to the nearest inch and nearest centimeter

- measure angles and draw complements and supplements, where possible, using a protractor

Seventh grade students will:

- select and use the appropriate units and tools to measure to the degree of accuracy required in a particular problem

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- measure the radius and diameter of circles to the nearest sixteenth inch and nearest millimeter

- using a protractor, measure angles of adjacent and vertical angles of intersecting lines

Eighth grade students will:

- select and use the appropriate units and tools to measure to the degree of accuracy required in a particular problem

- measure the length of the sides and heights of trapezoids to the nearest sixteenth inch and nearest millimeter

- using a protractor, measure angles of two lines cut by a transversal and angles of two parallel lines cut by a transversal

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

5.1 Measuring quantities indirectly using techniques of algebra, geometry, or trigonometry.

High school students will:

- use appropriate measurements to solve problems indirectly (for example, find the height of a flag pole using similar triangles)

- use measurements to solve real-world problems involving rate of change (for example, distance traveled using rate and time)

- given the rate of change, model real-world problems algebraically or graphically

- describe how changing the measure of one attribute of a geometric figure affects the other measurements

5.2 Selecting and using appropriate techniques and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements.

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High school students will:

- solve real-world problems involving multiple dimensions and express them using appropriate units of measurements
- given commonly-used multi-dimensional figures, decide what units and measurements need to be taken and what instruments are necessary to achieve a specified degree of accuracy
- given a commonly-used three-dimensional figure, select the appropriate units of measurement to determine volume and surface area
- find the distance between a pair of points in a coordinate plane using the distance formula
- compare and contrast the concepts of precision, accuracy, and error of measurement
- apply precision, accuracy and error of measurement to solve real-world problems

5.3 Determining the degree of accuracy of a measurement (for example, by understanding and using significant digits).

High school students will:

- use and understand significant digits
- in the context of a given problem, determine the accuracy required in the measurements to produce an answer with the appropriate number of significant digits

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Standard 6:

Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

GRADES K-4

In grades K-4, what students know and are able to do includes

6.1 Demonstrating conceptual meanings for the four basic arithmetic operations of addition, subtraction, multiplication, and division.

Kindergarten students will:

- add and subtract whole numbers by combining and separating objects
- draw pictures to form sets of up to ten items

First grade students will:

- demonstrate the operations of addition and subtraction of whole numbers with concrete materials
- link the operations of addition and subtraction, and equality with mathematical terms (for example, add, subtract and equal) and mathematical symbols (for example, +, –, =)

Second grade students will:

- using concrete materials, demonstrate and verbally explain addition of whole numbers with regrouping for two-digit numbers
- using concrete materials, demonstrate and verbally explain subtraction of whole numbers without regrouping for two-digit numbers
- using concrete materials or pictures, demonstrate multiplication without regrouping of whole numbers (for example, using arrays or grouping sets of objects)

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- using concrete materials or pictures, demonstrate division of whole numbers without remainders as partitioning of sets

- using concrete materials or pictures, demonstrate the inverse relationship of addition and subtraction of whole numbers

- using concrete materials or pictures, demonstrate multiplication of whole numbers as repeated addition

Third grade students will:

- using concrete materials, demonstrate and verbally explain addition and subtraction of whole numbers with regrouping for up to four-digit numbers

- using concrete materials or pictures, demonstrate multiplication with regrouping of whole numbers

- using concrete materials, demonstrate division of whole numbers with remainders as partitioning of sets

- using paper-and-pencil, demonstrate the inverse relationship of addition and subtraction of whole numbers

- using paper-and-pencil, demonstrate multiplication of whole numbers as repeated addition

Fourth grade students will:

- explain in writing what addition, subtraction, multiplication, and division of whole numbers means

- demonstrate the inverse relationship of multiplication and division of whole numbers

- demonstrate division of whole numbers as repeated subtraction

6.2 Adding and subtracting commonly used fractions and decimals using physical models (for example, 1/3, 3/4, 0.5, 0.75).

First grade students will:

- using concrete materials or pictures, add and subtract halves and fourths

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Second grade students will:

- using concrete materials or pictures, add and subtract halves, thirds, and fourths
- find the total value of coins not to exceed $1.00

Third grade students will:

- using concrete materials, demonstrate addition and subtraction of proper fractions with common denominators of ten or less
- using coins as models, add and subtract decimals in which sums and differences may exceed $1.00

Fourth grade students will:

- using concrete materials, demonstrate addition and subtraction of proper fractions with common denominators of twelve or less without regrouping
- using concrete materials, demonstrate addition and subtraction of mixed numerals with common denominators of twelve or less
- add and subtract decimals to the one-hundredths
- compute the total cost of items to $10.00
- determine change received for $10.00 or less

6.3 Demonstrating understanding of and proficiency with basic addition, subtraction, multiplication, and division facts without the use of a calculator.

First grade students will:

- demonstrate understanding of basic addition sums to 20 and subtraction differences of 10

Second grade students will:

- demonstrate understanding of basic addition and subtraction facts
- demonstrate automatic recall of basic addition and subtraction facts

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- use sums on an addition facts table to locate all addends for a particular sum (for example, 7 = 0 + 7, 7 = 1 + 6, . . .)

Third grade students will:

- demonstrate understanding of basic multiplication and division facts of 1's, 2's, 3's, 5's, and 10's
- demonstrate automatic recall of basic multiplication facts of 1's, 2's, 3's, 5's, and 10's
- continue automatic recall of basic addition and subtraction facts
- use a multiplication facts table to locate all factors for a particular product (for example, 6 = 1 x 6, 6 = 2 x 3, . . .)

Fourth grade students will:

- demonstrate understanding of basic multiplication and division facts through 100
- demonstrate automatic recall of basic multiplication and division facts through 100
- continue automatic recall of basic addition and subtraction facts

6.4 Constructing, using, and explaining procedures to compute and estimate with whole numbers.

Kindergarten students will:

- add and subtract whole numbers by combining and separating objects
- draw pictures to form sets of up to ten items

First grade students will:

- demonstrate the operations of addition and subtraction of whole numbers with concrete materials
- link the operations of addition and subtraction, and equality with mathematical terms (for example, add, subtract and equal) and mathematical symbols (for example, +, –, =)

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- using paper-and-pencil, demonstrate simple single-digit addition and subtraction

Second grade students will:

- use estimation techniques such as rounding and compatible numbers (numbers whose sum is 10) before performing operations
- using paper-and-pencil, demonstrate addition of two-digit whole numbers with and without regrouping
- using paper-and-pencil, demonstrate subtraction of two-digit whole numbers without regrouping

Third grade students will:

- use estimation techniques such as front-end rounding, rounding, and compatible numbers (numbers whose sum is 10, 100, 1,000..) before performing operations
- using paper-and-pencil, demonstrate the four basic operations of whole numbers including
  a) addition and subtraction of four digits
  b) multiplication of two digits by one digit, regrouping included
  c) division of two digits by a one-digit divisor obtaining one-digit quotients

Fourth grade students will:

- use estimation techniques such as front-end rounding, rounding, compatible numbers (numbers whose sum is 10, 100, 1,000...) and clustering (for example, 27 + 28 + 30 + 31 equals approximately 4 x 30 = 120) before performing operations
- using paper-and-pencil, demonstrate the four basic operations of whole numbers including
  a) multiplication of two digits by two digits and three digits by one digit with regrouping
  b) division of two digits by a one-digit divisor

6.5 Selecting and using appropriate methods for computing with whole numbers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator and computer methods.

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First grade students will:

- given a real-world problem-solving situation, use the correct operation (addition or subtraction with concrete materials) and appropriate method (mental arithmetic, estimation, paper-and-pencil, calculator, or computer) to solve the problem

Second grade students will:

- given a real-world problem-solving situation, use the correct operation (addition or subtraction) and appropriate method (mental arithmetic, estimation, paper-and-pencil, calculator, or computer) to solve the problem
- determine from real-world problems whether an estimated or exact sum or difference is acceptable

Third grade students will:

- given a real-world problem-solving situation, use the correct operation (addition, subtraction, or multiplication) and appropriate method (mental arithmetic, estimation, paper-and-pencil, calculator, or computer) to solve the problem
- determine from real-world problems whether an estimated or exact sum, difference, or product is acceptable

Fourth grade students will:

- given a real-world problem-solving situation, use the correct operation (addition, subtraction, multiplication, or division) and appropriate method (mental arithmetic, estimation, paper-and-pencil, calculator, or computer) to solve the problem
- determine from real-world problems whether an estimated or exact sum, difference, product, or quotient is acceptable

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

6.1 Using models to explain how ratios, proportions, and percents can be used to solve real-world problems.

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Fifth grade students will:

- use appropriate notations of ratio such as a/b, a to b, and a:b
- using concrete materials, determine commonly-used percentages (e.g., 25% and 50%) in real-world problems

Sixth grade students will:

- demonstrate the equivalence of fractions, decimals, and percents
- using concrete materials, determine commonly-used percentages in real-world problems

Seventh grade students will:

- demonstrate equivalence of fractions, decimals, and percents using proportions
- solve real-world problems using appropriate and convenient forms of fractions, decimals, and percents

Eighth grade students will:

- compute percent of increase or decrease in real-world problems
- apply proportional reasoning in problem-solving situations (for example, scale, similarity, percentage, unit pricing, simple interest, and rate)

6.2 Constructing, using, and explaining procedures to compute and estimate with whole numbers, fractions, decimals, and integers.

Fifth grade students will:

- demonstrate order of operations with whole numbers
- demonstrate with proficiency multiplication of whole numbers of three digits by two digits and three digits by three digits
- demonstrate with proficiency division of whole numbers with a two-digit divisor
- demonstrate equivalencies and simplification of proper fractions
- using paper-and-pencil, demonstrate with proficiency addition and subtraction of proper fractions and mixed numerals with common denominators and without regrouping

- using concrete materials, demonstrate addition and subtraction of mixed numerals with common denominators with regrouping
- using concrete materials, demonstrate addition and subtraction of proper fractions with unlike denominators
- demonstrate the inverse relationship of addition and subtraction of proper fractions and mixed numerals with common denominators
- demonstrate how the value of a fraction changes as the denominator increases
- demonstrate with proficiency addition and subtraction of decimals
- demonstrate the inverse relationship of addition and subtraction of decimals
- make change from any dollar denomination

Sixth grade students will:

- demonstrate order of operations including exponents with whole numbers
- choose the appropriate representation of the remainder in a division problem
- demonstrate equivalencies of mixed numerals and improper fractions
- simplify fractions
- using paper-and-pencil, demonstrate with proficiency addition and subtraction of fractions including mixed numerals
- using concrete materials, demonstrate multiplication and division of a common proper fraction and a whole number
- using concrete materials, demonstrate multiplication and division of proper fractions
- using concrete materials, demonstrate the meaning of multiplication and division of decimals by whole numbers
- demonstrate, by modeling, the inverse relationship of multiplication and division of common proper fractions
- count change up to the amount given

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Seventh grade students will:

- demonstrate order of operations with positive rational numbers and integers
- choose the appropriate representation of the remainder in a division problem
- using paper-and-pencil, demonstrate with proficiency computation of fractions
- using paper-and-pencil, demonstrate with proficiency the four basic operations of decimals
- demonstrate the inverse relationship of multiplication and division of decimals
- demonstrate the meaning of the four basic operations of integers
- using paper-and-pencil, demonstrate proficiency in computation of integers
- demonstrate the inverse relationship of addition and subtraction of integers
- demonstrate the inverse relationship of multiplication and division of integers
- demonstrate multiplication of integers as repeated addition
- using paper-and-pencil, solve real-world problems involving percents

Eighth grade students will:

- demonstrate order of operations with rational numbers
- demonstrate the meaning of the four basic operations of rational numbers
- using paper-and-pencil, demonstrate with proficiency computation of rational numbers
- demonstrate the inverse relationship of addition and subtraction of rational numbers
- demonstrate the inverse relationship of multiplication and division of rational numbers
- demonstrate multiplication of rational numbers as repeated addition

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6.3 Developing, applying and explaining a variety of different estimation strategies in problem-solving situations, and explaining why an estimate may be acceptable in place of an exact answer.

Fifth grade students will:

- determine from real-world problems whether an estimated or exact answer is acceptable
- use estimation techniques before performing operations

Sixth grade students will:

- determine from real-world problems whether an estimated or exact answer is acceptable
- use estimation techniques before performing operations

Seventh grade students will:

- determine from real-world problems whether an estimated or exact answer is acceptable
- use estimation techniques before performing operations

Eighth grade students will:

- determine from real-world problems whether an estimated or exact answer is acceptable
- use estimation techniques before performing operations

6.4 Selecting and using appropriate methods for computing with commonly-used fractions and decimals, percents, and integers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods, and determining whether the results are reasonable.

Fifth grade students will:

- determine whether information given in a problem-solving situation is sufficient, insufficient, or extraneous

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- given a real-world problem-solving situation, use the correct operation and appropriate method (mental arithmetic, estimation, paper-and-pencil, calculator, or computer) to solve the problem

- given a math sentence using the four operations with whole numbers, create and illustrate a real-world problem

- in a problem-solving situation, determine whether the results are reasonable and justify those results with correct computations

Sixth grade students will:

- determine whether information given in a problem-solving situation is sufficient, insufficient, or extraneous

- given a real-world problem-solving situation, use the correct operation and appropriate method (mental arithmetic, estimation, paper-and-pencil, calculator, or computer) to solve the problem

- given a math sentence with sums and differences of common fractions and decimals, create and illustrate a real-world problem

- in a problem-solving situation, determine whether the results are reasonable and justify those results with correct computations

Seventh grade students will:

- determine whether information given in a problem-solving situation is sufficient, insufficient, or extraneous

- given a real-world problem-solving situation, use the correct operation and appropriate method (mental arithmetic, estimation, paper-and-pencil, calculator, or computer) to solve the problem

- given a math sentence using the four operations with positive rational numbers and integers, create and illustrate a real-world problem

- in a problem-solving situation, determine whether the results are reasonable and justify those results with correct computations

Eighth grade students will:

- determine whether information given in a problem-solving situation is sufficient, insufficient, or extraneous

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- given a real-world problem-solving situation, use the correct operation and appropriate method (mental arithmetic, estimation, paper-and-pencil, calculator, or computer) to solve the problem

- given a math sentence using the four operations with rational numbers, create and illustrate a real-world problem

- in a problem-solving situation, determine whether the results are reasonable and justify those results with correct computations

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

6.1 Using ratios, proportions, and percents in problem-solving situations.

High school students will:

- convert from one set of units to another (for example, feet/minutes to miles/hour)

- solve a direct variation problem with proportions

- compute percent increases and decreases

6.2 Selecting and using appropriate methods for computing with real numbers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods, and determining whether the results are reasonable.

High school students will:

- apply appropriate computational methods to solve multi-step problems involving real numbers

- apply inverse operations of arithmetic and algebraic operations to solve problems involving real numbers

- determine the reasonableness of an answer

- solve problems involving very large and very small numbers using scientific notation

- apply numerical, graphical, or symbolic methods to solve problems involving real numbers and communicate with appropriate mathematical language

6.3 Describing the limitations of estimation and assessing the amount of error resulting from estimation within acceptable tolerance limits.

High school students will:

- determine when estimation is an appropriate method to solve a problem and describe what error might result from this estimate
- demonstrate an appropriate upper/lower limit on an estimate

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